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Science | Sciences
Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Advisory Report 2014/045

STOCK ASSESSMENT OF NAFO SUBDIVISION 3PS AMERICAN PLAICE (*HIPPOGLOSSOIDES PLATESSOIDES*)

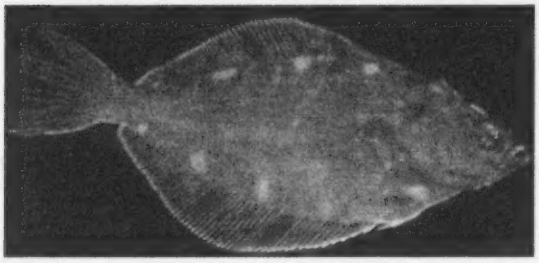

Photo: American Plaice
Photo By: Morgan, M. J.

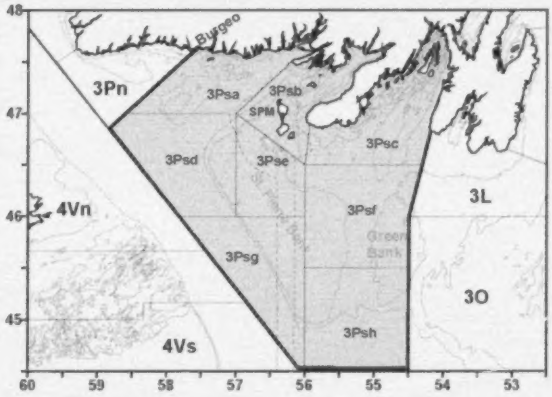

Figure 1. 3Ps management area (shaded) unit areas (solid lines) and economic zone around the French islands of St. Pierre and Miquelon (SPM) (dashed line)

Context:

The assessment was requested by Fisheries Management to provide the Minister with advice that will inform the management decisions for the 2014 fishing season. The specific request was to:

Provide an ecosystem overview (e.g., environment, predators, prey) of the stock.

Assess and report on the current status of the stock relative to Blim and Flim.

Describe bological characteristics (including age composition, size at age, age at maturity, year class strength and distribution) in relation to historic observations.

Evaluate the risk of being below Blim in annual projections (F=0, F current, current catch plus or minus 15 %) to 2016.

This Science Advisory Report is from the January 29-30, 2014 3Ps and 3LNO Haddock, 3Ps Pollock, and 3Ps American Plaice Stock Assessment. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Biomass in 2013 is estimated to be 60 % below B_{lim} (40 % *BMSY*) and therefore the stock is in the Critical Zone. The probability of being below B_{lim} is high (0.97). Current median fishing mortality is estimated to be 20 % of F_{lim} and the probability of being above F_{lim} (*FMSY*) is low (0.05).
- Although fishing mortality is low, the stock has declined since 2010.
- Projections of stock size were conducted under current productivity conditions at various catch levels from 2014 to 2016. Five scenarios were considered (zero catch, current catch, current catch + 15 % and current *F*). Although there was growth under all

scenarios, the stock remained well below B_{lim} in all cases. Additional projections determined that annual catches of 1000 t or more will result in stock decline.

- To increase the probability of stock recovery, there should be no directed fishing and bycatch should be kept to the lowest possible level.

INTRODUCTION

History of the Fisheries

Annual catches from this stock were highest from 1968 to 1973, exceeding 12,000 t in three years during this period. Since 1977 only Canada and France have been involved in this fishery. Catches averaged just less than 4000 t during the 1980's but rapidly declined after 1991. There has been a moratorium on direct fishing of American plaice since September of 1993. Catches of American plaice since that time have been by-catch in other fisheries. Catch increased substantially after 1995, and was over 1000 t in each year from 2001 to 2003. However, catch has been declining since then and was 300 t, 151 t and 103 t in 2011, 2012 and 2013, respectively.

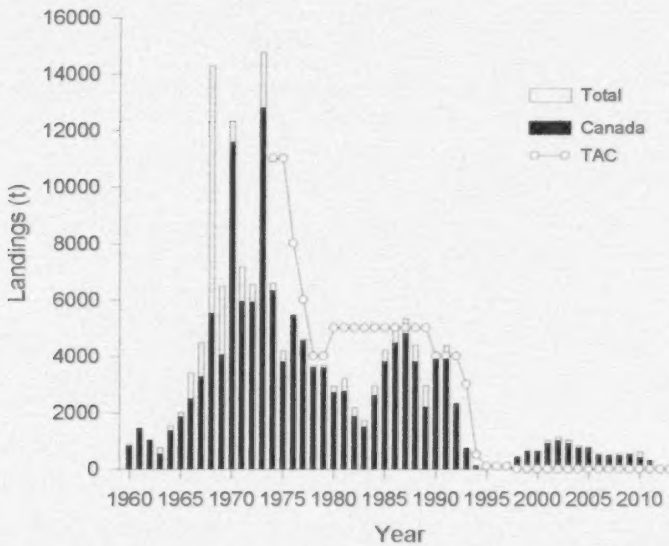

Figure 2. Landings and total allowable catch (TAC) in tons of American Plaice in Subdivision 3Ps by year. The bars show the landings with the black portion of the bars indicating Canadian landings and the white portion the landings by other countries. The line with dots indicates the TAC.

Species Biology and Ecology

American Plaice is a benthic marine flatfish with an elongated, strongly laterally compressed body. When young fish hatch from the egg at or near the surface they have the 'normal' fish orientation. During development they undergo a metamorphosis resulting in lateral compression so that they swim on their side and both eyes are on the upper side of the body, facing right. The eyed side is typically red to grayish brown and uniform in colour, whereas the blind side is white. The head is generally small but with a relatively large mouth.

American Plaice are usually considered a cold-water species with reported catches in temperatures from -1.5 to 13°C, but they are most numerous within a temperature range from just below zero to around -1.5°C. Once settled, adults and juveniles frequently inhabit the same

areas over depths ranging from 20 to 700 m with a preference for depths in the range of 100 to 300 m.

American Plaice are generally a slow growing and moderately long-lived species that exhibit sexual dimorphism in that the females grow faster and are larger than the males for any given age. Spawning in Subdiv. 3Ps is widespread.

American Plaice are highly opportunistic feeders throughout their life cycle, feeding on whatever prey items are available in appropriate sizes for ingestion and varying with fish size, locality and seasonally. Adults and juveniles feed on polychaetes, echinoderms, molluscs, crustaceans and fish (capelin, sand lance, other flatfish, etc.).

ASSESSMENT

A Bayesian Surplus Production Model was applied to catch data from 1960-2013 and survey data from 1980-2013. Production models estimate relative levels of biomass and fishing mortality more precisely than absolute levels. This means that the ratio of biomass to the biomass giving maximum sustainable yield (B_{MSY}) and the ratio of fishing mortality to the fishing mortality giving maximum sustainable yield (F_{MSY}) are more precise than biomass and fishing mortality themselves. For this reason, stock trajectories and reference points are usually reported as these ratios (B_{ratio} and F_{ratio}) and status determined relative to F_{MSY} and B_{MSY}, with the biomass limit reference point set as a percentage of B_{MSY}. Consistent with the DFO Precautionary Approach (PA) framework, B_{lim} (the biomass limit reference point) is 40 % B_{MSY}, (where B_{MSY} is the equilibrium biomass that can produce the maximum sustainable yield), the upper stock reference is 80 % B_{MSY} and F_{lim} (the removals reference point) is F_{MSY} (the equilibrium fishing mortality that can produce B_{MSY}). Stock status relative to these reference points was estimated from the model.

Stock size estimated from the surplus production model decreased fairly steadily from the late1960s to a low in 1994 of less than 10 % of B_{MSY}. Biomass increased slowly from 1994 to 2008 but has not increased since. Biomass in 2013 is estimated to be only 40% of B_{lim} and therefore the stock is in the Critical Zone. Taking uncertainty into account, the probability of being below B_{lim} is high (0.97). Fishing mortality reached a peak in 1991 after which it declined for several years. Fishing mortality increased again to above F_{MSY} in the late 1990s when landings started to increase. It has declined since 2010 and current median fishing mortality is estimated to be 20 % of F_{lim}. The probability of being above F_{lim} is low (0.05).

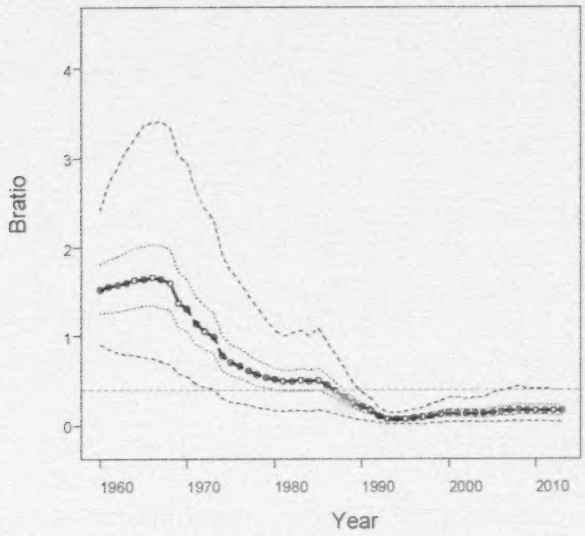

Figure 3. Estimated ratio of stock biomass to B_{MSY} from surplus production model. The median, 70 % and 95 % credible intervals are shown. The red horizontal line is B_{lim} (i.e. 40 % of B_{MSY}).

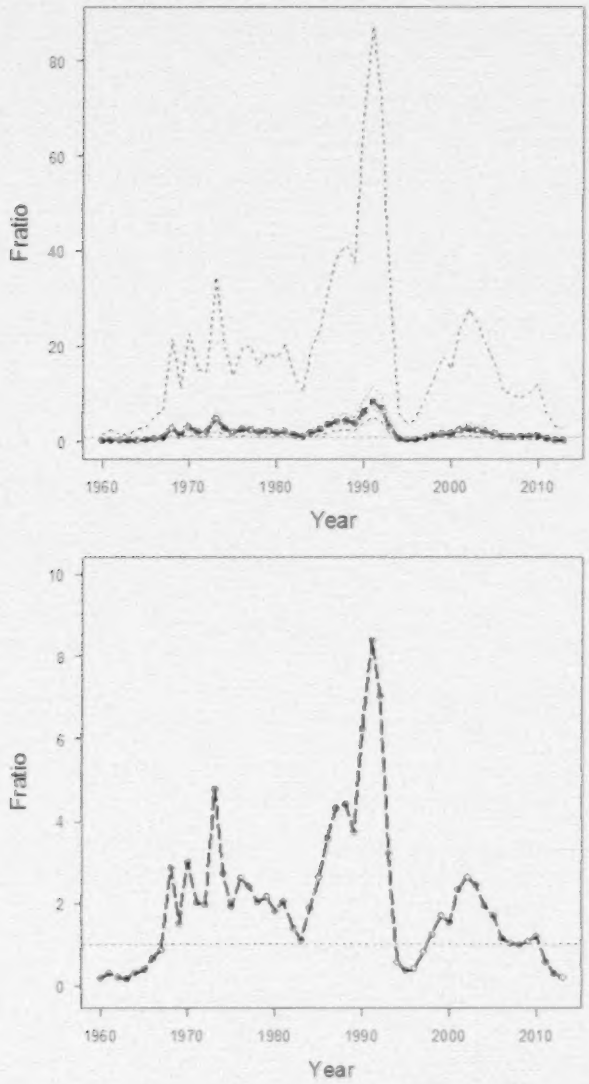

Figure 4. Estimated ratio of fishing mortality to F_{MSY} from surplus production model. The median, 70 % and 95 % credible intervals are shown in top. The red horizontal line is F_{lim} (where F_{ratio}=1). Bottom shows only the median to better show the trends.

Projections of stock size under the different levels of fishing requested in the Terms of Reference (ToR) were conducted. Current catch in these projections was taken as the average of the last 3 years which was 185 t. Although there was some growth under all scenarios there was a high probability that the stock would remain below B_{lim} in all cases.

Table 1. Results of projections of stock size and fishing mortality for Subdivision 3Ps American plaice from 2014 to 2016 at different catch and fishing mortality levels as requested in the ToR.

Scenario	Median Bratio	Percent of Blim	Probability below Blim	Median Fratio	Probability above Flim
F=0 Catch=0					
2014	0.18	0.45	0.94	NA	NA
2015	0.20	0.50	0.90	NA	NA
2016	0.22	0.55	0.85	NA	NA
Current catch					
2014	0.18	0.45	0.94	0.33	0.11
2015	0.20	0.50	0.90	0.31	0.11
2016	0.21	0.52	0.87	0.28	0.11
Current catch +15%					
2014	0.17	0.42	0.94	0.39	0.13
2015	0.18	0.48	0.91	0.36	0.13
2016	0.20	0.50	0.87	0.33	0.13
Current catch -15%					
2014	0.18	0.45	0.94	0.28	0.09
2015	0.20	0.50	0.91	0.26	0.09
2016	0.21	0.52	0.87	0.23	0.09
Current F					
2014	0.18	0.45	0.94	NA	NA
2015	0.20	0.50	0.91	NA	NA
2016	0.22	0.55	0.87	NA	NA

Additional projections were conducted to determine the level of catch that would result in population decline over the next three years. These projections indicate that annual catches of 1000 t or more will result in stock decline. However, at these higher levels of catch there is a high probability that fishing mortality will be above the limit reference point.

Table 2. Results of projections of stock size and fishing mortality for Subdivision 3Ps American plaice from 2014 to 2016 at different catch levels to determine the catch at which there is no growth in the stock.

Catch	Median Bratio	Percent of Blim	Probability below Blim	Median Fratio	Probability above Flim
600 t					
2014	0.173	0.43	0.95	1.14	0.58
2015	0.180	0.45	0.92	1.09	0.55
2016	0.186	0.48	0.90	1.04	0.52
800 t					
2014	0.169	0.42	0.95	1.53	0.77
2015	0.172	0.42	0.93	1.50	0.74
2016	0.174	0.42	0.93	1.48	0.71
900 t					
2014	0.167	0.42	0.95	1.75	0.84
2015	0.168	0.42	0.93	1.73	0.81
2016	0.168	0.42	0.91	1.73	0.78
1000 t					
2014	0.165	0.41	0.95	1.96	0.88
2015	0.164	0.41	0.94	1.97	0.86
2016	0.162	0.40	0.92	1.99	0.84

Environment and Ecosystem

Local water temperatures remained above normal in most areas in 2013 but show a decrease over 2011-12 values. In 3Ps bottom temperatures ranged from 3.3 °C to 2.9 °C, an approximate decrease of 1 standard deviation. In general, all environmental indices indicate a continuation of

the warmer than normal trend throughout the area since the mid-1990s. During the past 2 years however temperatures have decreased compared to the record warm conditions of 2011.

There is a clear warming signal in the 3Ps region; since the early 1990s, bottom temperature during the spring survey has been increasing at an average rate of around 3 % per year. Although trends of the fish community in the 1980s and early 1990s are potentially confounded with changes in the RV survey (e.g. timing of survey, sampling effort, gear change), it seems clear that the fish community declined during the mid-1980s and early 1990s. This decline was also accompanied by a decrease in the average fish size. Overall, the biomass and abundance of the fish community has increased since the mid 1990s. Increases in biomass have been moderate, while increases in abundance have been more clear and led by planktivore species like Sandlance, and to a lesser extent Herring. During this period, average fish size has shown ups and downs, without a consistent trend. Changes in biomass/abundance (BA) ratio at the fish community level can be explained by changes in community composition, like recent increases in planktivores. Among piscivores, Atlantic Cod is the dominant species in this functional group. Pollock has shown fluctuations over time, with 2010 and 2012 being relatively strong years compared to all others. During the early 2010s, dominance of Cod seems to be increasing among piscivores, but other gadoids (e.g. Silver Hake) also seem to be increasing within this functional group. Among large benthivores, American Plaice biomass levels have shown very few changes since the mid 1990s. This functional group has been dominated by Thorny Skate and American Plaice. Haddock has shown fluctuation but is not a dominant species among large benthivores. The observed warming of this system, together with recent increases of "warmer-water" species like Sandlance, Silver Hake, and Pollock suggests that this ecosystem could be undergoing structural changes.

There is limited diet information for 3Ps. The available data for American Plaice (Spring 2013) indicates a diet dominated by Sandlance, Brittle/Basket Stars and other echinoderms. This is different from 3LNO samples which show a diet with a higher proportion of Capelin and Sandlance.

Sources of Uncertainty

Although catch and fishing mortality have both declined in the last three years, so have the survey indices of biomass. These trends are reflected in the model and indicate that productivity may have declined in this stock. It is not known if productivity will continue to change.

Sensitivity of the assessment model to the priors (particularly the prior on the catchability of the Engels survey) should be explored further.

CONCLUSIONS AND ADVICE

Biomass in 2013 is estimated to be 60 % below B_{lim} (40 % *BMSY*) and therefore the stock is in the Critical Zone. The probability of being below B_{lim} is high (0.97). Current median fishing mortality is estimated to be 20 % of F_{lim} and the probability of being above F_{lim} (*FMSY*) is low (0.05).

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SOURCES OF INFORMATION

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Morgan, M.J., Dwyer, K.S., Healey, B.P., and Rideout, R.M. 2014. An assessment of the American Plaice (*Hippoglossoides platessoides*) stock in NAFO Subdivision 3Ps. Can. Sci. Advis. Sec. Res. Doc. 2014/098.

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